What is Xen?

- a type-1 hypervisor
- small footprint (less than 90K LOC)
- GPLv2
- powers the largest public clouds in production
Xen Architecture

- Dom0
  - PV backends
  - HW drivers
- DomU
  - PV Frontends
- DomU
  - PV Frontends
- DomU
  - PV Frontends

Xen

Hardware
Xen Architecture: driver domains

- disaggregation and componentization
- security and isolation
- resilience
- hardware vendors can run their drivers in separate VMs
  - could run in a RTOS environment
  - hidden from the user
    - media codecs, crypto keys, etc.
Xen on ARM: not just a port

- a lean and simple architecture
  - removed cruft accumulated during the years
  - no emulation, no QEMU
  - use PV drivers for IO as early as possible
  - one type of guest
  - exploit the hardware as much as possible

- a very good match for the hardware

- clean architecture = small code base
Xen on ARM architecture

Device Tree describes …

GT
GIC v2
2 stage MMU

EL0
EL1
HVC
EL2
**Code size**
sometimes smaller is better

<table>
<thead>
<tr>
<th>Package</th>
<th>Common</th>
<th>ARMv7</th>
<th>ARMv8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>xen/arch/arm</td>
<td>5,122</td>
<td>1,969</td>
<td>821</td>
<td>7,912</td>
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<tr>
<td>C</td>
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<td>406</td>
<td>344</td>
<td>5,773</td>
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<tr>
<td>ASM</td>
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<td>477</td>
<td>2,139</td>
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<tr>
<td>xen/include/asm-arm</td>
<td>2,315</td>
<td>563</td>
<td>666</td>
<td>3,544</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>7,437</td>
<td>2,532</td>
<td>1,487</td>
<td>11,456</td>
</tr>
</tbody>
</table>

- **X86_64-bit:** ~120,000LOC (~4,000 ASM)
- **ARM code** ~ 1/10 x86_64 code
Achievements of the last 18 months

- First Xen on ARM talk at Xen Summit 2012
- Xen support for ARM upstream in Linux 3.7
- Xen running on real ARM hardware
- Citrix announces that will be joining Linaro
- Xen 64-bit on ARM64
- Xen support for ARM64 upstream in Linux 3.11
- Xen 4.3 released with ARM and ARM64 support
- Part-time Xen ARM hacking starts
- Xen 4.4 release
A growing community

Xen-devel ARM traffic from Jan 2013:

- **5663** emails: 472 emails per month!
- **43%** of which are **not** from Citrix
Xen Hardware support

Xen 4.4-rc2:
- Versatile Express Cortex A15
- Arndale board
- ARMv8 FVP
- Allwinner SunXi (Cubieboard 2)
- TI OMAP5
- Applied Micro X-Gene
Porting Xen to a new board

- Xen only relies on GIC and GT

- platform specific code in Xen is reduced to:
  - secondary cpus bring up
  - UART drivers
  - any platform specific bootup quirks (ideally none)
Xen features

Xen 4.4-rc2:
● 64-bit guest support on ARMv8
● stable hypercall ABI
● multiboot support
● PSCI support

Xen 4.3:
● basic lifecycle operations
● memory ballooning
● scheduler configurations and vcpu pinning
Linux features

Linux v3.13:
- SWIOTLB
- PV framebuffer, mouse and keyboard

Linux v3.11:
- dom0 and domU support
- 32-bit and 64-bit support
- SMP support
- PV disk, network and console
Android on Xen on ARM

- Android is based on the Linux kernel
  - KitKat is based on Linux 3.8: just recompile the kernel to get Xen on ARM support!
- Additional work needed to support client devices (compass, GPS, etc.) on multiple VMs
  - easy to export 1 device to 1 VM
  - otherwise each type of device needs a PV drivers pair
PV Protocols

- shared ring protocol
- software interrupts AKA event channels
- consensual memory sharing: grant table
- easy to write
- plenty of examples
  - network, block, console, PCI, keyboard, mouse, framebuffer, sound, SCSI, USB, …
Porting other OSes to Xen on ARM

- No invasive modifications needed
- Only some new drivers:
  - grant table, event channels, xenbus
  - PV drivers for network, block, console, etc.
- BSD drivers already exist in NetBSD and FreeBSD, can they be reused?
- FreeBSD port to Xen on ARM in progress
A look into the future

- SMMU-500 support in Xen
- device assignment
- UEFI booting
- ACPI support
Xen for automotive: why?

- type-1
- small footprint
  - small codebase
  - no QEMU, no emulation
- driver domains / service VMs
  - componentization
  - security
  - support for legacy drivers
- supports Linux out of the box
- easy to port other OSes to Xen on ARM
More Information

- http://www.xenproject.org

- Xen on ARM @wiki.xenproject.org goo.gl/FKNXe

Questions?
Fin.